describe one of the two carrier supports 37. An enlarged detail of carrier support 37 is shown in Figure 12. Page 14, line 3 et seq. clearly describes a "bearing housing 79 which is adapted to provide a Z-motion to the substrate carrier" 42 and is marked with arrows to show its Z motion. Applicants request withdrawal of the allegation or some suggestion by the Examiner.

The Examiner at page 2, paragraph 1 objects to the specification "for not disclosing (a) how the carrier supports 37, 38 are able to position the substrate/wafer vertically." Figure 8 and the specification at page 11 describes how the substrate carriers 37 and 38 may be rotated 90° from their position shown in Figure 8 so that substrate carriers 42 and 43 may pass each other in the "X" direction shown. The Examiner asks "Is the substrate positioned horizontal on the substrate carrier 41,42 . . . ? Yes! The question is not understood! Applicants have described an adapter plate 81 and gasket 82 (Figure 12) for holding a substrate 12 tightly on the substrate carriers 42 or 43. The substrate remains flat in a horizontal plane and is moved as shown in Figures 13 to 20. Some prior art dicing saws hold the wafer horizontal or flat and move it under the saw blade or blades performing one or two cuts in a single direction as shown in Ono cited.

Claims 1 to 4 and 5 to 17 are each rejected under 35 U.S.C. 102 or 103 on the principal reference Ono. The rejection of these claims on Ono is predicated on erroneous assumptions of Ono which will now be explained.

First Ono teaches two wafer support stations but requires three station positions and two alignment stations as well as two load/unload stations, thus, the machine requires about thirty percent more floor space as well as the

added cost of a second alignment station and a second machine for the load/unload station (not shown or described). The Ono heads are independently movable in a Z direction.

The Examiner observes at page 5, paragraph 13 that "Ono does not teach . . . counter-rotating blades" and independent support means . . . for engaging the blade with a wafer."

The Examiner erroneously cites Carter for counter rotating blades. This is NOT true! The two blades 496a and 496b when viewed from the side are said to rotate in the same direction. Any other explanation of simultaneous cutting could not be found in this reference! Clearly, the reference does not suggest it could be combined with Ono. See Carter claim 1 for simultaneous scanning and sawing!

Claim 1 calls for "a bi-directional cutting saw . . ." Ono explains his saw blade cuts in only one direction of "X"-movement. Thus, Ono teaches away from applicants. In order for Ono to cut a wafer with two blades, the trailing blade always has to cut after the leading blade and must move an extra distance measured by the separation of the Ono saw blades. Stated differently, the blade 158A is always moving counter clockwise in Figure 3. The wafer moves left to right, blade 158A cuts first as blade 158B has yet to start a cut. Blade 158A finishes its cut long before blade 158B. Time and motion studies show applicants' saw cuts at least thirty percent faster and is cheaper to manufacture! The allegation that "One teaches a bi-direction cutting saw" is clearly in error and is traversed. Applicants can supply affidavits to this effect for purpose of appeal, however, the Examiner cannot find the word bi-directional as used by applicants in the Ono patent. The applicants have shown and described in their Fig-

iures 18 to 20 how blade 57 finishes a cut and how blade 58 makes its cut while the wafer is being retracted. This is a true cut in both directions of the movement of the wafer. This is bi-directional cutting and the blades must rotate in opposite directions. Ono does not do this and must retract both blades and start a new cut from left to right!

Claim 1 also calls for "positioning each said carrier support sequentially from a load/unload station to a vision position station . . ." Ono has two load/unload stations and two vision stations 10A and 10B. Ono is inoperable without two stations. Applicants have eliminated the need for dual stations!

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Claim 1 calls for moving each carrier support reciprocally in the X direction. Ono uses movable frames 14A and 14B which support wafers to be diced. The frame is not a carrier support capable of supporting substrates. TO support the substrates, the frame most be modified. Ono frames 14A and 14B both ride on and are supported by two rails 12, thus, the frames never pass each other! The first two elements of claim 1 call for two transport means that are side by side parallel to each other so that they may pass each other. Ono has no wafer support that can do this!

Claim 1 calls for "cutting the substrate/wafer as it moves in both X-axis directions." This is new and not taught or suggested by Ono or Carter. Applicants do not know of any prior art dicing or singulation saw that cuts in both directions of the X-axis!

Having explained the differences in applicants' claim 1 and the prior art, applicants' Figures 13 to 15 show carrier supports 42 and 43 which have passed each other in the X-axis direction while cutting a substrate 12.

The Examiner objected to claim 4 for lack of vertically positioning means in the specification. Bearing

vertical direction if needed. The Z movements may only be required when large wafers pass each other in the "X" direction.

The Examiner objects to claims 1 to 7, 10 and 11 under 35 U.S.C. 112(2). Claim 1 at line 18 is amended to explain that the substrated wafers are cut while they are mounted on said carrier support.

The Examiner alleges there is no antecedent basis for "the movable frame" in claims 10 and 11. Claim 11 does not include any "movable frame" and claim 10 is dependant from claim 8 which includes "a movable frame" at line 4. The use of "the" in claim 10 is deemed proper.

The Examiner has erroneously rejected claim 1 under 35 U.S.C. 102(b) and then proceeds to define some of the structure of Ono. Ono teaches a "dicing saw" which cannot be used for singulation of substrates unless modified! The Ono saw blades cut the wafer one after the other while rotating in the same direction and the wafer is moved in a single left to right direction while being cut.

Claim 1 has a preamble followed by six distinct elements. Ono may use two of the six elements, however, Ono does not teach or suggest the preamble or four of the elements in claim 1 and clearly does not teach the novel mode of operation. Ono would appear to be inoperable without two vision stations and two loading stations. The wafer frames 14A and 14B are both on two rails and cannot pass each other. The applicants have discussed these differences in detail previously. The rejection under 35 U.S.C. 102(b) is based on erroneous statements and is traversed! Claim 1 is allowable.

The Examiner has rejected claims 2 and 3 under 35 U.S.C. 103(b). These dependant claims include allowable claim 1. Ono has no substrate carrier support and has no adapter plate and gasket for supporting a substrate, therefore claims 2 and 3 are allowable.

The Examiner rejects claims 5 to 17 under 35 U.S.C. 103(a) on Ono in view of Carter with the proper observation that Ono does not teach counter-rotating blades and bi-directional cutting of the wafer. If this is now a proper observation, then the rejection of claim 1 was improper by the Examiner's own admission.

The Examiner cites Carter for teaching counter rotating saw blades. While it may be true that the motors shown in Carter's Figure 1 do rotate in opposite directions the blades must rotate in the same direction or the blade would not cut the flitch which moves in one direction. If the Examiner has a different opinion, then, he should cite the column and line of the specification where the description differs from the claims which state otherwise.

The Examiner attempts to combine Carter with Ono in the rejection of claim 8 which cannot be done because neither reference suggests taking parts from Carter and modifying the parts and then using them in Ono. The rejection is improper. Further, neither reference teaches a bi-directional cutting saw or the first five elements set forth in claim 8. Claim 8 is allowable as now written. Any suggestion by the Examiner to improve the claim language would be appreciated.

Claims 9 to 16 are dependent from allowable claim 8 and provide novel structure and its mode of operation, thus, are also allowable.

Independent claim 17, rejected on Ono in view of Carter, is a system claim for singulating substrates. Neither reference teaches cutting substrats. Accordingly, neither reference teaches or suggests a first or a second substrate carrier. Surely, neither teaches one substrate carrier behind the other. Neither reference has any carrier that can move in X, Z and theta so as to pass each other. Neither reference has counter rotating saw blades or the sequenced mode of operation stated in the last element. Since the cited art does not teach how to cut substrates as distinguished from wafers or wooden beams, there is no teaching of the preamble or the six elements of claim 17.

Claim 18 (and claim 4) were deemed to be allowable if rewritten in independent form. Since these claims are now dependent from claim 1 and 17 which are allowable over Ono and Carter, it would be premature for the applicants to introduce new independent claims in this application.

Applicants request a second action on the merits before any final action because the grounds for rejection in the first action were and are clearly based on erroneous applications of the cited art. Any suggestion by the Examiner to place this application in better form for allowance would be appreciated.

This new singulation saw is a commercial success!

Applicants enclose new pages 11 and 23 of the specification.

Applicants also enclose amended and retyped claims 1 and 17.

A listing of claims is:

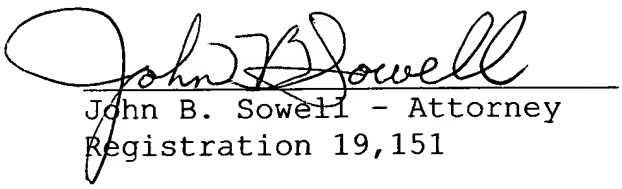
Claim 1 (Amended)

A copy of specifications pages 11 and 25 and claims 1 and 17 showing amendments made is enclosed.

A request for extension of time and fees is enclosed.

Reconsideration and allowance is now requested.

Respectfully submitted,



John B. Sowell - Attorney
Registration 19,151

Direct Tel (610) 649-4815
Direct Fax (610) 649-8143
Enclosures (8)
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linear actuators 35 and 36 are positioned accurately relative to the rotating saw blades and parallel to each other.

Refer now to Figure 8 showing an isometric drawing of the singulation saw 8 showing the counter-rotating saw blades and a Y-axis positioning drive for the saw and the support gantry for the working head that supports the dual spindle saws. The linear actuators 35 and 36 are shown supporting their carrier supports 37 and 38 mounted on mounting and alignment blocks 41 which fit into the recesses 27 of the base or support 26 for the saw 8. It will be noted that the substrate carriers 42 and 43 at the top of the carrier supports 37 and 38 are adapted to receive rectangular substrate strips and are provided with a vacuum source V which extends below the substrate (not shown) and that the substrate carriers 42 and 43 are accurately positionable from one position shown to an orthogonal position 90 degrees from that shown so that the substrate carriers may pass each other during operation of the transport system. The novel system includes a vision system comprising a vision system camera 44 mounted on a Y-axis linear actuator 45 comprising a Y-axis motor 46. The Y-axis actuator is moveably mounted on an X-axis linear actuator which is fixedly mounted on a mounting bracket 48 which mounts on the base or support 26. It will be understood that the camera 44 may be accurately positioned in X and Y over a substrate carried by one of the substrate carriers 42 or 43 in either of their orthogonal positions when at the leftmost vision station end under the vision camera system position as shown at substrate carrier 42. Camera 44 may be mounted over station 3.

Refer now to both Figures 8 and 9 showing the singulation saw 8 which is supported by the base or support 26

ABSTRACT OF THE DISCLOSURE

[In a] A bidirectional singulation saw for sawing either substrates or wafers there is provided a pair of counter-rotating saw blades mounted for independent movement in a vertical direction for alternately engaging with a first substrate to be singulated. A transport system comprising a pair of parallel substrate carriers reciprocates [the] a first substrate under the pair of saw blades [while] as alternate ones of the saw blades are engaged to cut the substrate in two X-axis directions. While the first substrate is being cut, the second or other substrate carrier sequentially unloads a cut substrate, loads a new uncut substrate and then moves the uncut substrate to a vision system for determining the position of the substrate relative to the second carrier.[and then positions the] The positioned second carrier and its substrate are now in a standby position ready to be cut by the pair of saw blades that are cutting the first substrate.[As the first cut substrate is moved to an unload position, the new uncut substrate is moved into a cutting position; thus, a minimum loss of cutting time is incurred and a minimum amount of cooling water is needed.]

17 (Amended). A system for singulating substrates or wafers, comprising:

a first moveable substrate carrier mounted on a first linear actuator,

a second moveable substrate carrier mounted behind said first linear actuator on a second linear actuator,

means for independently controlling the X, Z and theta [or Z-] motion of each of said substrate carriers,

means for independently controlling the X-position of said substrate carrier on its linear actuator,

said means for controlling the X-position of said substrate carriers comprising means for reciprocally moving one of said substrate carriers in a cutting station under a pair of counter rotating saw blades mounted in the same cutting plane, and

simultaneously positioning the other of said substrate carriers at an unload and loading station, then to a vision positioning station and then to a position outside of said cutting station ready to enter the cutting station when the substrate carrier in the cutting station moves out of the cutting station, thereby virtually eliminating any loss of cutting time.

1 (Amended). A bi-directional cutting saw of the type for use in singulation of substrates and dicing of wafers, comprising:

first and second linear transport means arranged side by side parallel to each other;

each said transport means comprising a linear actuator and a carrier support moveable by said linear actuator;

means for positioning each said carrier support sequentially from a load/unload station to a vision position station and then to a singulation cutting station;

each said carrier support being reciprocally moveable back and forth in an X-axis direction at said singulation/cutting station;

singulation/cutting means for separating semiconductor type substrates/wafer devices one from another while they are mounted on said carrier support by cutting the substrate/wafer as it [passes] moves in both X-axis directions; and

simultaneously cutting a first substrate/wafer on a first carrier support on a first linear transport means while simultaneously loading and positioning a second substrate/wafer on a second carrier support ready for cutting on [a] the second linear transport means, thereby reducing lost cutting time to a minimum.